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DISTRIBUTION AND STATUS OF THE HARLEQUIN DUCK, *Histrionicus histrionicus* ON THE GALLATIN NATIONAL FOREST, MONTANA

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SUMMARY

Harlequin duck surveys were conducted on 12 streams in the Gallatin National Forest and two streams in the Custer National Forest during the period May - August, 1990. Most stream sections were surveyed at least twice, once during the early part of the season and a second time later in the season. Survey sections were selected by size and gradient. Harlequin ducks were observed only on a short section of the Boulder River on three separate days. A total of 18 harlequins were seen but these probably represent only 15 individual ducks as some probably were seen more than once. The breakdown of observations is as follows: 19 May - one pair; 6 June - five adult males, one pair, and one adult female; 23 August - eight individuals of undetermined sex and age. Behavioral observations included swimming, loafing, preening, feeding, and mating. The number of harlequin observations was too small to make meaningful comparisons or predictions of habitat use patterns. The observations that were made compare favorably with results obtained

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Harlequin duck surveys were conducted on 12 streams in the Gallatin National Forest and two streams in the Custer National Forest during the period May - August, 1990. Most stream sections were surveyed at least twice, once during the early part of the season and a second time later in the season. Survey sections were selected by size and gradient. Harlequin ducks were observed only on a short section of the Boulder River on three separate days. A total of 18 harlequins were seen but these probably represent only 15 individual ducks as some probably were seen more than once. The breakdown of observations is as follows: 19 May - one pair; 6 June - five adult males, one pair, and one adult female; 23 August - eight individuals of undetermined sex and age. Behavioral observations included swimming, loafing, preening, feeding, and mating. The number of harlequin observations was too small to make meaningful comparisons or predictions of habitat use patterns. The observations that were made compare favorably with results obtained from a study in Grand Teton National Park. In general, harlequins appear to prefer streams of low gradient (<3 degrees) with gently sloping banks (<45 degrees) which have a dense cover of perennial shrubs. Several streams in the study area appeared to offer suitable habitat that was not being used by harlequins. However, because of their size, color (especially hens and young), and habitat preference it is difficult to spot harlequins in the field. Although the survey effort was very thorough it is possible that some harlequins may have been overlooked on some streams. If other populations do exist in this area they are likely to be small and transitory. Additional survey work in this area will be dependent on the needs of management agencies. Further study on harlequin duck biology and habitat needs would be more profitable in areas with higher harlequin duck densities.

INTRODUCTION

The harlequin duck (Histrionicus histrionicus) is a member of the tribe Mergini (sea ducks) and as such is taxonomically related to the eiders (Somateria sp. and Polysticta stelleri), scoters (Melanitta), and oldsquaw (Clangula hyemalis) (Johnsgard 1978). However, because of their preference for isolated, swift-flowing mountain streams as breeding habitat, harlequin ducks appear to be more similar ecologically to the torrent duck (Merganetta armata) of South America and the blue duck (Hymenolaimus malachorhynchos) of New Zealand (Bengston 1966).

The distribution of the harlequin duck is divided into distinct eastern and western populations (Figure 1) (Bellrose 1980). The relatively small eastern population extends across northeastern North America, Greenland, and Labrador, reaching its highest density in Iceland (Bengston 1966). The western population is found near the west coast of North America from northern California to Alaska, with the greatest numbers occurring in the Aleutian Islands; a small number also may be found along the coast of the Siberian peninsula (Bellrose 1980).

Throughout their range harlequin ducks tend to winter on rocky wave-pounded ocean coasts and breed on isolated swift-flowing mountain streams (Bengston 1966, Johnsgard 1978). The majority of the western population winters on the Aleutian Island National Wildlife Refuge where up to one million harlequins may be found (Bellrose 1980). Further south, Christmas bird counts have found only 500 birds along the coast of British Columbia and

INSERT FIGURE 1 HERE

only 25-50 birds along the coasts of Washington and Oregon; there also are scattered reports of harlequins wintering along the coast of northern California (Bellrose 1980). Occasionally harlequins are sighted wintering inland in the Rocky Mountains but these reports are rare (see Wallen 1987).

The breeding range of the western population extends inland, following the Cascade and Sierra ranges south into northern California, and the Rocky Mountain range west and south, across northern Idaho and western Montana, into the northwestern corner of Wyoming (Bellrose 1980). Considered rare in Idaho (Burleigh 1972), recent surveys have found breeding harlequins in several drainages in the Idaho panhandle north of the Lochsa River (Wallen and Groves 1988, 1989). In Montana, harlequins breed in small numbers along the Rocky Mountain chain from Glacier National Park (GNP) (Kuchel 1977) to Yellowstone National Park (YNP) (T. McEneaney, pers. obs.) and scattered points in between (D. Genter, pers. obs.). Breeding harlequins also are known from Grand Teton National Park (GTNP), Wyoming (Wallen 1987).

Most detailed knowledge of harlequin duck breeding biology has come from studies in Iceland (Bengston 1966, 1972). In North America, harlequin duck breeding chronology and breeding habitat have been described for Prince William Sound, Alaska (Dzinbal 1982), Glacier National Park (Kuchel 1977), and Grand Teton National Park (Wallen 1987).

Concerning breeding chronology, pair formation usually occurs on the wintering grounds (Bellrose 1980). In GTNP, Wallen

(1987) found that harlequin ducks began to arrive on the breeding grounds during the first week of May. Pairs commonly were observed on the streams until the onset of incubation in late June or the first week of July. At this time drakes and unpaired hens left for the coast while nesting hens remained secluded on the nest. Broods did not begin to appear on the streams until mid-July or early August. Hens and broods remained on the breeding streams until mid-September after which, they also departed for the coast. This chronology is consistent with the observations of Kuchel (1977) and Dzinbal (1982).

Wallen (1987) characterized harlequin duck breeding habitat in GTNP as low gradient (<3 degrees) mountain streams with meandering channels, dense perennial shrubs on the banks, high water quality, and little or no human disturbance. He also found that harlequins appeared to prefer stream sections that had >3 midstream loafing sites per 10 m and avoided sections where both banks approached the stream at >45 degree angle (i.e. bedrock canyons).

In Iceland, harlequin ducks tended to nest in dense shrubs on river islands or in the cracks and crevices formed by large lava blocks along stream banks, again under dense shrubs (Bengston 1966, 1972). No nest sites have been found during studies in North America but probable nesting habitat has been inferred from observations of recently hatched broods. Kuchel (1977) considered dense shrubs surrounding beaver ponds or abandoned meanders to provide harlequin nesting habitat in GNP.

Similar habitat did not occur along breeding streams in GTNP so Wallen (1987) considered that dense shrubs along the lowest gradient (<1 degree) sections of streams where breeding pairs had been observed was the most likely nesting habitat in that area.

OBJECTIVES

Proper management of a wildlife species is dependent on knowledge of the distribution and abundance of that species, along with its habitat needs and behavioral characteristics. Therefore, the objectives of this survey effort were first, to document the distribution and abundance of harlequin ducks on the Gallatin National Forest, and second, to record the habitat characteristics of stream sections used by harlequin ducks and record observations of harlequin duck behavior.

STUDY AREA AND METHODS

Harlequin duck surveys were conducted on sections of 12 streams on the Gallatin National Forest and two streams on the Custer National Forest (Figure 2). Streams were selected based on size (>10 m in width) and gradient (<3 degrees), following the criteria used by Wallen and Groves (1988, 1989) in northern Idaho.

Surveys were conducted from May to August with most stream sections surveyed at least once during May or June and again

INSERT FIGURE 2 HERE

during July or August (Table 1). Because this survey was not formally initiated until the first week of June, little work was accomplished during May, which may be the best time for observing pairs (Wallen and Groves 1988, 1989; Cassirer 1989). No surveys were conducted during the first half of July because of the low probability of observing harlequins during this time.

EXCEPT AS NOTED BELOW, SURVEYS WERE CONDUCTED BY WALKING UPSTREAM AS CLOSE TO THE SHORE AS POSSIBLE AND SCANNING BOTH UPSTREAM AND DOWNSTREAM WITH BINOCULARS. PORTIONS OF THE GALLATIN RIVER FROM SQUAW CREEK TO BIG SKY, WHERE THE RIVER IS EASILY OBSERVED FROM THE ROAD, WERE SURVEYED BY BICYCLE, WITH FREQUENT STOPS TO SCAN WITH BINOCULARS; THE GALLATIN RIVER FROM BIG SKY TO TAYLOR CREEK WAS SURVEYED BY CANOE. PORTIONS OF TAYLOR CREEK, MILL CREEK, AND THE BOULDER RIVER (19 MAY ONLY) WERE CHECKED BY CAR, AGAIN WITH FREQUENT STOPS TO SCAN WITH BINOCULARS. INFORMATIONAL POSTERS ABOUT HARLEQUIN DUCKS WERE PLACED AT FOREST SERVICE CAMPGROUNDS IN THE SURVEY AREA BY PERSONNEL OF GALLATIN NATIONAL FOREST. POSTERS ALSO WERE HANDED OUT TO RAFTING/FISHING OUTFITTERS ON THE GALLATIN RIVER.

STREAM LENGTHS AND/OR GRADIENTS WERE DETERMINED FROM USGS TOPOGRAPHICAL MAPS. GENERAL HABITAT CONDITIONS WERE DESCRIBED QUALITATIVELY FOR LOCATIONS WHERE HARLEQUIN DUCKS WERE OBSERVED AND GENERALLY FOLLOWED THE CHARACTERISTICS USED BY WALLEN (1987). THESE CHARACTERISTICS INCLUDE BANK VEGETATION (CONIFEROUS FOREST, SHRUBLAND, MEADOW, OPEN), BANK SLOPE (<>45 DEGREES), CHANNEL TYPE (MEANDERING, BRAIDED, STRAIGHT, BEDROCK CANYON), STREAM

TABLE 1. HARLEQUIN DUCK SURVEY ROUTES AND DATES, GALLATIN AND CUSTER NATIONAL FORESTS. MAY - AUGUST 1990.

STREAM	DATES	START					END			
✓ BEAVER	21 JUN 8 AUG	T11S	R3E	S21	N1/2		T10S	R3E	S33	N1/2
		T11S	R3E	S21	S1/2		T10S	R3E	S33	S1/2
✓ BOULDER	19 MAY 6 JUN 16 JUL 7 AUG 13 AUG 23 AUG	T3S T4S T6S T6S T4S T4S	R12E R12E R12E R12E R12E R12E	S26 S15 S4 S4 S15 S36	W1/2 NE1/4 SE1/4 NE1/4 NE1/4 SW1/4		T6S T4S T6S T6S T4S T6S	R12E R12E R12E R12E R12E R12E	S21 S36 S21 S21 S36 S21	SW1/4 SW1/4 SW1/4 SW1/4 SW1/4 N1/2
✓ EAST BOULDER	19 MAY 25 JUL 13 AUG	T3S T4S T3S	R13E R13E R13E	S29 S2 S4	N1/2 W1/2 NE1/4		T3S T4S T4S	R13E R13E R13E	S32 S14 S4	SE1/4 S1/2 NE1/4
✓ WEST BOULDER	28 MAY 2 AUG	T3S T3S	R11E R11E	S25 S36	N1/2 NW1/4		T4S T4S	R11E R11E	S16 S28	SE1/4 SW1/4
✓ CABIN	21 JUN 8 AUG	T11S T11S	R3E R3E	S15 S15	S1/2 S1/2		T11S T11S	R3E R3E	S11 S11	S1/2 S1/2
✓ GALLATIN	23 MAY 27 JUL 30 JUL 1 AUG 21 AUG	T4S T4S T5S T6S T9S	R3E R4E R4E R4E R4E	S29 S29 S33 S13 S2	SE1/4 SE1/4 SE1/4 NW1/4 SW1/4		T5S T5S T5S T6S T6S	R4E R4E R4E R4E R4E	S15 S33 S25 S32 S32	NW1/4 SE1/4 S1/2 SE1/4 SE1/4
✓ GRAYLING	22 JUN 9 AUG	T12S T12S	R5E R5E	S10 S10	W1/2 E1/2		T12S T12S	R5E R5E	S9 S9	SW1/4 SW1/4
✓ HYALITE	16 JUN 19 JUN	T3S T4S	R6E R6E	S32 S9	SW1/4 NW1/4		T4S T4S	R6E R6E	S9 S15	NW1/4 W1/2
✓ WEEK MADISON	8 AUG	T11S	R3E	S22	NE1/4		T11S	R3E	S22	SW1/4
✓ MILL	21 MAY 14 AUG	T5S T5S	R9E R9E	S32 S32	SE1/4 SE1/4		T6S T6S	R10E R10E	S33 S19	W1/2 SW1/4
✓ WEST ROSEBUD	14 JUN	T6S	R17E	S33	NW1/4		T7S	R16E	S2	SW1/4
✓ SQUAW	23 MAY 27 JUL	T5S T4S	R4E R4E	S1 S33	NE1/4 SE1/4		T5S T5S	R5E R5E	S6 S6	W1/2 W1/2

TABLE 1. (CONTINUED)

STREAM	DATES		START				END			
STILLWATER	12	JUN	T5S	R15E	S21	NE1/4	T5S	R15E	S32	SW1/4
	13	JUN	T5S	R15E	S32	SW1/4	T6S	R14E	S35	SW1/4
	29	AUG	T5S	R15E	S32	SW1/4	T6S	R14E	S24	SW1/4
	30	AUG	T6S	R14E	S24	SW1/4	T7S	R14E	S10	SW1/4
✓ TAYLOR	9	AUG	T9S	R4E	S2	SW1/4	T9S	R4E	S7	SE1/4

GRADIENT, AND AVAILABILITY OF MIDSTREAM LOAFING SITES (0, 1-3, >3/10 m). STREAM FLOW DATA FOR THE BOULDER RIVER DRAINAGE WAS DETERMINED BY MEASUREMENTS TAKEN 5 SEPTEMBER USING THE METHODS OF ROBBINS AND CRAWFORD (1954). SEASONAL (1990) AND HISTORIC (1981-1990) STREAM FLOW DATA FOR THE BOULDER AND GALLATIN RIVERS WAS PROVIDED BY THE U.S. GEOLOGICAL SURVEY (HELENA, MT). GAUGING STATIONS ARE LOCATED ON THE BOULDER RIVER AT BIG TIMBER AND THE GALLATIN RIVER AT GALLATIN GATEWAY. THE BIG TIMBER STATION DOES NOT PROVIDE ACTUAL STREAM FLOW FOR THE BOULDER RIVER STUDY AREA BUT SHOULD ACCURATELY REFLECT RELATIVE SEASONAL AND YEARLY CHANGES THAT OCCUR AT THE STUDY SITE. THE GALLATIN GATEWAY STATION PROVIDE ACTUAL STREAM FLOW DATA FOR MUCH OF THE GALLATIN RIVER STUDY AREA.

RESULTS

SECTIONS OF 14 STREAMS WERE SURVEYED IN GALLATIN AND CUSTER NATIONAL FORESTS DURING MAY - AUGUST 1990 (FIGURE 2). THESE STREAMS REPRESENT ALL THE POTENTIAL HARLEQUIN DUCK BREEDING HABITAT IN GALLATIN NATIONAL FOREST, BASED ON SIZE AND GRADIENT REQUIREMENTS. A DESCRIPTION OF SURVEY ROUTES IS GIVEN IN TABLE 1.

A TOTAL OF 18 HARLEQUIN DUCKS WERE OBSERVED ON THE BOULDER RIVER OVER THREE SEPARATE DAYS. THESE PROBABLY REPRESENT 15 INDIVIDUAL DUCKS. HARLEQUINS WERE NOT OBSERVED ON ANY OTHER STREAM. SOME SIGHTINGS WERE REPORTED IN RESPONSE TO THE POSTERS BUT THESE WERE NOT RELAYED TO THE FIELD INVESTIGATOR AND HAVE NOT BEEN VERIFIED.

HARLEQUIN DUCK OBSERVATIONS

19 MAY (6:00PM): ONE PAIR WAS OBSERVED ON THE Boulder River (T6S R12E S9) 0.4 miles (odometer reading) upstream from the Hilleary bridge (Figure 3). The pair initially was seen from the road and appeared to be resting in the relatively calm water near the west shore, about 40 m downstream from a set of shallow riffles. As we approached for a closer view the pair quickly moved upstream with the female in the lead. Both ducks maintained a low profile with the head held low to the water. However, both needed the assistance of their wings to negotiate the riffles. Once beyond the riffles the pair relaxed but continued to move upstream. They disappeared from view after about five minutes of observation. Habitat: Meandering channel with smooth moderate current below a small section of shallow riffles. Both banks sloped gradually into the water (<45 degrees) and were forested, with only a light shrub understory which grew to be moderately dense (i.e. screening the river from the road) later in the season. No loafing sites were available. Distance from the road varied from 5 to 30 m.

6 June (11:30am): Five adult males were observed on the Boulder River (T6S R12E S9) 0.5 miles (odometer reading) upstream from the Hilleary bridge (Figure 3). This group of drakes was seen floating downstream with the main current, which was separated from a calm backwater area by a gravel bar. The main current was strong enough in this stretch to raise standing waves approximately 0.5 m high. The ducks appeared to be doing nothing more than traveling downstream. They quickly disappeared from view. Habitat: A straight reach in a generally meandering channel with a strong current stacked up in short standing waves. Both banks sloped gradually to the water. The west bank was forested with an understory of moderately dense shrubs; the east bank was an open gravel bar which separated the main channel from a backwater area. There were no loafing sites in this stretch. Distance to the road was 30-40 m.

6 June (11:30am): One pair was observed on the Boulder River (T6S R12E S9) 0.5 miles (odometer reading) upstream from the Hilleary Bridge (Figure 3). The pair was first seen in a backwater area along the east bank and was observed for 20 minutes. During the first 10 minutes the pair casually swam around in small circles, feeding by dipping the bill into the water, the hen more often than the drake. During this period the drake would approach the hen and peck at the back of her neck. Over the last 3-4 minutes of this time period the frequency and intensity of these pecks quickly increased, culminating with mounting which lasted 4 seconds. The hen then escaped but was

rapidly pursued by the drake. Within a matter of a few seconds their behavior calmed and the pair swam out to the gravel bar. They spent the next 10 minutes walking about along the shore and poking among the rocks with their bills, occasionally stopping to preen for a few seconds. They were still involved in this behavior when I left to continue the survey. This pair was seen about two hours later (2:00pm) resting on the same gravel bar.

Habitat: Backwater area formed by a log jam and separated from the main channel by a gravel bar (see description above). The east bank sloped gently to the water and was forested, with an understory of dense shrubs. Because of the high water at this time of year, many of the bank shrubs were flooded, providing cover for the harlequins on the water. Midstream loafing sites consisted of a few partially submerged logs (1-3/10 m) and the large gravel bar. Distance from the road was 30-40 m.

6 June (4:00pm): A single adult hen was observed on the Boulder River (T6S R12E S3) about 400 m downstream from Fourmile Creek. The hen initially was sighted on a rock on the east bank of the river. She spent about 1 minute preening then entered the water and was observed feeding by diving for a couple minutes more before disappearing from view. Habitat: Meandering channel with a strong current broken into sections of whitewater by large subsurface rocks. The hen used an eddy along the east bank which was formed by a large boulder which jutted out into the current. The east bank was cut out and approached the water very steeply. Adjacent to the water it was composed of large rocks and

driftwood and above it was primarily bare soil. The west bank sloped gently to the water and was forested, with a dense understory of shrubs which made viewing difficult. No midstream loafing sites were present because of the high water level but there were abundant loafing sites along the east bank. Distance from the road was >200 m but a well-worn trail followed the west bank and an undeveloped campground was located on the west bank about 100 m upstream.

23 August (2:00pm): A group of 8 harlequins of undetermined age and sex was observed on the **Boulder River** (T6S R12E S12) about 500 m downstream from the Alpine Lodge (Figure 3). A short time previous to this observation a small group of harlequins was seen flying upstream from a point 1-2 km downstream from where the group of 8 was observed. It is believed that these were two observations of the same group. This group was observed for about 15 minutes as they slowly worked their way downstream, feeding along the way by bill dipping, head dipping, tipping-up, and diving. The type of feeding behavior appeared to be related to water depth. Individuals of the group occasionally would walk out on shore and preen for a few seconds before returning to the group. Group members never were separated by more than a total of 15 m. The group traveled about 100 m downstream before disappearing from view. Habitat: Meandering stream channel with a relatively gentle current broken by a short stretch of shallow riffles. Both banks sloped gently to the water and were forested. Shrub cover was moderately dense on both banks. There were no

INSERT FIGURE 3 HERE

midstream loafing sites but short gravel bars did occur at intervals along both banks. Distance from the road was about 200 m but a well-worn trail followed the east bank. This trail was screened from the river by the moderately dense growth of shrubs.

Boulder River Survey Area

The Boulder River was surveyed from Falls Creek campground to Hicks Park campground. Total distance covered was 26.06 km and elevation ranged from 1585 m (5200 ft) to 1932 m (6340 ft). This equated to a mean gradient of 1.3% or 0.6 degrees. The specific section of the river from which all harlequin duck observations came (Figure 3) ran from approximately 400 m downstream of Fourmile Creek to 300 m upstream of Clear Creek. The length of this section was 5.14 km and the elevation ranged from 1865 m (6120 ft) to 1914 m (6280 ft), for a mean gradient of 0.9% or 0.4 degrees. The channel meandered the entire length of the survey area with the exception of Hell's Canyon, which is a straight, narrow, bedrock canyon. This was the only section of the Boulder River survey in which both banks approached the water at >45 degrees angle. Flow volume, measured on 5 September, was 24.95 cms (81.86 cfs) which was the lowest flow during the survey period. Flow measurements were taken in the harlequin duck observation area (Figure 3). Stream flow data recorded at the USGS gauging station in Big Timber is included in Table 2. Similar data from the Gallatin River are presented for comparison.

Historic stream flow values over the past 10 years also are presented for both rivers (Table 3). Water quality as determined by clarity remained high throughout the survey period although the water was slightly cloudy during the highest flows in May.

Table 2. Monthly average, maximum, and minimum stream discharge (cfs) for the Boulder and Gallatin rivers, May-Sept 1990 (USGS, Helena, MT).

		Boulder	Gallatin
May	mean	723	1498
	min	369	866
	max	1960	2740
June	mean	2206	2904
	min	958	1980
	max	4220	4800
July	mean	1227	1250
	min	327	730
	max	3490	2500
Aug	mean	206	577
	min	119	471
	max	316	714
Sept	mean	119	418
	min	75	378
	max	194	484

Other Wildlife Observations

Dippers (Dolichonyx oryzivorus) were common on all streams with the exception of Taylor Creek. Common mergansers (Mergus merganser) were observed on the East Boulder, West Boulder, Stillwater, and Gallatin Rivers. No more than three common mergansers were seen on any one survey day with the exception of 21 August when a group of 25 and another group of 10 flightless

common mergansers were seen on the Gallatin River between Big Sky and Taylor Creek. Mallards (Anas platyrhynchos) and teal (Anas spp.) were seen in small numbers in quiet pools and backwater areas along the Boulder, West Boulder, and Stillwater rivers. Canada geese (Branta canadensis) were observed along calm sections of the West Boulder and Stillwater rivers.

Table 3. Average, minimum, and maximum stream discharge for the Boulder and Gallatin rivers for 1981-1990 (USGS, Helena, MT).

year	mean ^a	Boulder		Gallatin		
		max(mo) ^b	min(mo) ^c	mean ^a	max(mo) ^b	min(mo) ^c
1981	532	2722(jun)	76(sep)	860	3211(jun)	466(sep)
1982	626	2916(jun)	288(sep)	*	*	*
1983	543	2419(jun)	221(sep)	*	*	*
1984	622	2628(jun)	212(sep)	*	*	*
1985	383	1441(jun)	172(aug)	717	2048(may)	506(sep)
1986	471	2692(jun)	110(aug)	884	3691(jun)	522(sep)
1987	330	1152(may)	111(sep)	587	1565(may)	426(sep)
1988	393	2020(jun)	28(sep)	655	2191(may)	364(sep)
1989	455	2366(jun)	111(sep)	672	2477(jun)	401(sep)
1990	474	2206(jun)	119(sep)	785	2904(jun)	418(sep)

a- annual mean (all days), b- highest monthly mean for period May - Sept., c- lowest monthly mean for period May - Sept., * - no data.

DISCUSSION

The number of harlequin duck observations was too small to make meaningful comparisons or predictions of habitat use patterns. However, the observations that were made compare favorably with the results obtained from a study in GTNP (Wallen 1987). For example, no observations were made in locations where both stream banks approached the water at >45 degree angle or

where bank vegetation was open. The Boulder River also had a mean gradient <3 degrees, which Wallen (1987) considered a requirement of harlequin breeding habitat. However, all the streams surveyed during this study had a mean gradient in this range. Finally, the harlequin duck observation area (Figure 3) appeared to have suitable nesting habitat in terms of backwater areas and beaver ponds with dense perennial shrubs around the edges. However, these areas usually were within a few meters of a heavily used road. Public use along the river appeared to be moderate except in close proximity to the road and campgrounds. Wallen (1987) found that harlequin ducks, especially hens with broods, tended to avoid areas with much human activity.

The only streams surveyed that did not appear to offer suitable harlequin duck habitat were Mill, Taylor, Cabin, and Hyalite creeks. Mill Creek paralleled the road for most of its length, which forced the creek into a narrow rocky channel with steep banks. The only area that appeared suitable in terms of channel and gradient had open banks with little vegetation. Taylor Creek was at the lower limit of size and the upper limit of gradient and had little or no vegetation along the banks. This was the only stream surveyed where dippers were not observed. Both Cabin and Hyalite creeks probably were too small and steep for harlequin ducks, having channels confined to narrow canyons.

The West Boulder and Stillwater rivers were very similar in physiogamy with the exception of the Stillwater River's much greater size. Both had sections of calm open water flowing

through grass/sedge meadows interspersed with sections with narrow canyons and steep gradients. Suitable habitat did appear to occur but probably is limited in extent. The lower section of Beaver Creek appeared to provide all the features of suitable habitat but the upper half had wide gravel/rock banks which provided no cover along the stream.

The Gallatin River and West Rosebud Creek appeared to offer suitable habitat throughout much of their length but both suffered from heavy human use, particularly fishermen. This may have discouraged harlequins from using these area. Squaw Creek also provided good habitat but may have been on the small side and also may have suffered some from high levels of human activity.

The East Boulder River was the best candidate for harlequin duck observations of all streams surveyed. It had all the habitat features identified by Wallen (1987) and was the only stream surveyed that did not have a road or trail running along its length. Grayling Creek also appeared to meet all the qualifications except possibly that of size.

CONCLUSION

Because of their size, color (especially hens and young), and habitat preference, harlequin ducks are difficult to spot in the wild. The possibility of overlooking individuals during surveys must be considered to be quite high. Although I believe

that the survey effort as presented in this report was very thorough, this report does not provide positive proof for the absence of harlequin ducks in the streams examined. However, if populations exist on streams beside the Boulder River they are likely to be very small and transitory.

The Stillwater and Boulder drainages may be at the eastern edge of harlequin range in Montana. Because so little is known of the habitat requirements and limits of breeding harlequin ducks it is difficult to say with certainty that suitable habitat does exist in these areas in any great amount. Determining the habitat requirements of harlequin ducks continues to be the most pressing need for proper management of this species on its breeding grounds.

Additional survey work in this area will be dependent on the informational needs of the management agencies. Increasing human activity along streams and the potential for water quality degradation from a variety of sources are probably the main impacts facing harlequin duck habitat in southwestern Montana. Additional study on the biology and habitat needs of harlequin ducks would be more fruitful in areas with higher harlequin densities.

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